

## **Nova Scotia Agricultural Bioenergy - Energy Strategy Policy Input**

Notes from Mike Main, NSAC, Dec 14, 2007. This does not necessarily reflect the views of the NSAC Administration or other NSAAC employees.

Bioenergy represents a significant potential source of renewable energy in NS.

This document lists some potential agricultural sources that should be recognized in Nova Scotia's energy strategy.

### **1. Manures.**

Nova Scotia farms produce about 900,000 tonnes manures annually. If 1/3 of these manures were processed by anaerobic digestion (AD), they would generate 19 million cubic meters of methane gas, which could be used to generate about 23GWH of electricity, and a similar quantity of heat, equivalent to about 2MW continuous capacity.

Anaerobic digestion is advantageous in that it reduces manure odors and volume, and allows convenient solid/liquid and nutrient fractionation if desired, which can be valuable as a manure nutrient management tool. This could be particularly important for Kings County, where manure nutrient production exceeds the needs of crops in several areas.

A recent assessment suggests that interest rate reduction and/or cost sharing of capital expenditures, plus incentives to bring net electrical price above \$0.09/KWH, would be required to make manure digestion and electricity production feasible for the majority of farms in the province (Brown et al. 2007). Higher support levels would be required to induce many producers to invest in AD equipment, due to a high degree of uncertainty and significant transitions in the livestock sectors.

***Because of the combined environmental benefits, incentive programs to encourage manure biogas production should be established.***

### **2. Crop Residues**

Only small quantities of crop residues are currently available in Nova Scotia. About 30,000 tonnes of grain straw are produced, but much of this is used for animal bedding, mulching berries, or returned to soil to maintain soil humus. Perhaps 30 thousand tonnes of wet wastes from carrot and other vegetable production are produced annually. (No exact data is available). Some of this is currently used to feed livestock, but there may be some opportunity to use a portion for biogas or bioethanol production.

***Potential opportunities to use existing crop and processing residues should be explored.***

### **3. Specified Risk Materials (SRMs)**

An estimated 4900T/y of mixed animal slaughter waste containing specified risk material is produced in Nova Scotia, in addition to about 2000 T/y of dead stock (Estimate from Don MacQueen, NSDE). Actual carcass wastes from animals 30+ months of age in NS is estimated at 570 T/y, but usually the material is not separated. This is a poor bioenergy resource, as a mixed, wet material, but the need to deal with the material is urgent from a health and food safety standpoint. Utilizing this material as a small fraction of feedstock in a biomass combustion or pyrolysis system could be a win-win option.

*Means to use SRMs in bioenergy systems should be explored.*

#### **4. Crop Bioenergy Potential**

Up to 1.2 million hectares of Nova Scotia land could support agricultural activities, but much of this is forested. Approximately 170,000 ha of agricultural land is currently in crop or pasture production in Nova Scotia. An additional 45,000 ha of cleared land is not currently utilized. A portion of this could be available for bioenergy crop production, along with other land that is currently underutilized.

Table 1 lists approximate potential of a few major bioenergy pathway options. The solid fuel options can provide substantial greenhouse gas reductions, whereas the liquid fuel options offer less potential. The options based on willow coppice or biomass grasses also can be sustainably produced on large acreages (good and marginal soils), while annually cultivated crops require higher class or improved soils. Sugar beet, in particular, has high potential to induce soil erosion, due to late season soil disturbance at harvest. Therefore, in order to allow for erosion protection and soil building crops in rotation, the overall available hectares that can be planted in any given year is smaller,

There is currently considerable ‘grassroots’ interest in grass pellet fuel systems, and boilers are in development by at least three companies or entrepreneurs in the Maritime region. There is also producer interest in other biofuels, since several existing farm sectors are producing poor returns.

Since Nova Scotia currently imports considerable feed grains, and feed grain prices have approximately doubled between fall 2005 and fall 2007, there is some current incentive for increased feed grain production on higher class and improved farmland. Hence, subsidy support of biofuel production based on cultivated crops may not be advisable, since similar or greater greenhouse gas reduction could be had by replacing grains now transported long distances.

However, biomass grass and coppice crops could occupy an important niche as soil building crops in rotation, as buffer zones to absorb runoff from more intensive crops, or in biomass production on more marginal lands. Also, nitrous oxide emissions (a potent greenhouse gas) are comparatively low under these crops than cultivated crops. And, soil carbon levels typically will be higher under grass or willow than under cultivated crops. This could translate to significant C sequestration.

**Table 1. Potential crop production for bioenergy**

Crop	Yield T/ha (DM)	Target price \$/T	Expected Land available for sustainable production (ha)	Potential gross income to crop producers <sup>1</sup> \$/yr, region	Life cycle energy gain (GJ ha <sup>-1</sup> ) <sup>2</sup>	Approx. net GHG reduction (T CO <sub>2</sub> eq y <sup>-1</sup> ) <sup>3</sup>
willow coppice (for electricity + heat])	10.0	\$60	40,000	\$24,000,000	90	700,000
Biomass Grass (pellet heating fuel)	7.6	\$90	40,000	\$27,000,000	80	300,000
Canola (biodiesel)	2.5	\$300	25,000	\$19,000,000	30	60,000
Sugar beet for ethanol	10	200	12,500	\$25,000,000	30-60?	35,000

<sup>1</sup> Assumes potential as if each choice were the only crop produced on available and suitable land.

<sup>2</sup> Based on Main et al (2007), and further estimates by Mike Main re sugar beet ethanol. Energy gains are as bioenergy or biofuel products (electricity and/or heat, or ethanol).

<sup>3</sup> Assumes that electricity replaces coal generated electricity; assumes bio-heat replaces heat from light fuel oil; assumes biodiesel and bioethanol replace conventional diesel and gasoline respectively. Assumes 25% efficiency in electrical generation plus 27% additional energy captured and used for heating; assumes pellets are burned at 70% overall efficiency. Accounts for energy used in transport and processing of biomass.

The economics of bioenergy crop production are uncertain, due to lack of experience, and uncertainties around the efficiency of smaller processing facilities, especially for bioethanol. Electricity markets are least favorable economically, due to the competition from cheap coal. But, generation in a co-generation context would appear to have good economic potential with minimal incentive. Pellet heating fuel production appears to have good stand-alone economic potential based on current electricity and fuel oil prices for heating. (1 tonne pellets @ \$220 cost = 450 liter fuel oil @ \$380 cost). However, heating system conversion costs could be high. Also, boilers are still in development, and consumer experience lacking.

***Nova Scotia energy policy should encourage local bioenergy crop production and local bioenergy market development, for those systems that show large specific GHG reduction potential.***

***Pilot projects in public buildings have high potential for benefits, and such projects should be encouraged in new provincial energy policy***

## 5. Larger Context Issues

Supporting sustainable local bioenergy through preferential tax treatment, subsidy support, and higher taxing of ‘dirty’ current alternatives, will stimulate broad-based economic development in Nova Scotia. This will bring sustained returns to the Government of Nova Scotia through income and sales tax revenue. In contrast, oil and gas production is well established technology, stands alone financially, and will, over time, expire.

Also, renewable energy development in the region has been hampered by a lack of local expertise. Nova Scotia has a large University community. The Nova Scotia Agricultural College is well poised to become a center of expertise in agricultural bioenergy, and also broader energy efficiency and renewable energy issues facing agriculture. The Nova Scotia Department of Agriculture is well poised to support technology extension activities through support of Agrapoint, and through internal positions. The potential exceeds current human capacity.

***The Nova Scotia energy strategy should recognize the long-term environmental and economic benefits of sustainable, local bioenergy production.***

***Policy support should reflect the degree of greenhouse gas mitigation that is generated by bioenergy systems.***

***Nova Scotia energy policy should support innovation and technology extension capacity in bioenergy, through partnership with the NS Department of Agriculture.***

## **References**

Brown, B.B. Yiridoe, E.K. and R. Gordon. 2007. Impact of single versus multiple policy options on the economic feasibility of biogas energy production: Swine and dairy operations in Nova Scotia. *Energy Policy* 35 (2007) 4597–4610

Main, M., Joseph, A., Zhang, Y. and MacLean, H. L. 2007. Assessing the energy potential of agricultural bioenergy pathways for Canada. *Can. J. Plant Sci.* 87: 781–792.